Figs. 6 to 9 represent several stems and plates isolated in the manner described and magnified 350 times.

Fig. 6 shows a bent and half tube-shaped stem; Fig. 7 a plate with two apertures; Fig. 8 a plate with alternate and parallel thicker and thinner parts; Fig. 9 a ramified stem of similar structure. In Fig. 6 the shape of the cross-section is indicated. The alternately thinner and thicker parts in Figs. 8 and 9 correspond to the lamellæ of the lime in which they laid imbedded, and therefore probably have their origin from these.

Now we have only to consider the fibres, which in many parts of the Eozöon, at the borders of the calcareous parts carrying the stems, surround the serpentine-like bands, but which in other parts pass right through the serpentine. In Fig. 5 these fibres are marked F, while the serpentine is designated by S. A very well-defined band of fibres is seen in Fig. 10 (magnified 200 times), between the serpentine S and a piece of lime in which obliquely ascending stems are cut right across at the surface of the section. O is a crystal of olivine in course of decomposition, and therefore no longer possessing sharp edges.

The fibres are imperfectly developed micro-crystals of chrysotile, which like olivine and serpentine consists of silica and magnesia. In many fibre-bands, with the application of strong magnifying powers, it is observed that the fibres are very small four-sided prisms. In Fig. 11, near F, such fibres are shown, magnified 500 times; to the left are long, less distinct, needle-shaped chrysotile crystals, besides lime (K).

(*To be continued.*)

NOTES

We have received from the U.S. Signal Office the monthly *Bulletins* for November and December, 1874, January, 1875, and January, February, and March, 1877. We hope shortly to begin, through the courtesy of General Myer, the regular publication of a map exhibiting the simultaneous monthly means in meteorology of the whole of the Northern Hemisphere. The immense value of such a publication to meteorological science we need not point out, and the enterprise of the U.S. Signal Office in working out and making public these data is beyond praise.

The Astronomical Museum established by Admiral Mouchez in the Paris Observatory may be considered as now complete. Besides the pictures of the principal celestial objects and portraits of the directors of the Paris Observatory, the hall contains a number of objects connected with astrology as well as astronomy, and a number of historical instruments, as the bar which was used for measuring the Peruvian degree, the similar instrument which was taken to Lapland by the Northern Commission; the pendulum used by Duperrey, and that used by Fraissinet for measuring the intensity of gravity in remote lands, the former being constructed by Fresnel; the bi-refracting prism used by Arago for his great optical discoveries, the portable meridian circle designed by Admiral Mouchez, &c., &c.

A solution of a problem which has lately acquired some celebrity, viz., *How to colour a map with four colours without colouring adjacent districts the same colour*, has just been obtained by Mr. A. B. Kempe, and will shortly appear at length in the *American Journal of Mathematics*. The fact that a map could be so coloured was stated by Prof. De Morgan to be well-known to map-makers, but no proof of the fact or means of solving the problem have hitherto, it is believed, been given. Some notion of the difficulty involved may be gathered from the fact that a very slight alteration in a map may render it necessary to recolour it throughout. Mr. Kempe's solution may be roughly described as follows:—He points out that every map must have a district in it with less than six surrounding it. This district he gets rid of by putting a patch over it which just projects over its boundaries, all boundaries which meet the patch being produced to meet in a point on the patch. A new map is thus obtained having one district less. This map must also have a district with less than six surrounding it which can be patched out in the same way. Continuing this process the map can at last be reduced to a blank sheet composed of overlapping patches. This can be coloured with a single colour. Stripping off the patches in the reverse order and colouring the districts as they are exposed, Mr. Kempe shows that whenever the 1, 2, 3, 4, or 5 districts surrounding a newly exposed one absorb all four colours, the colours can be rearranged in the map so as to reduce the surrounding colours to three, thus leaving a fourth for the exposed district. Thus successively taking off patches, rearranging the colours in the map, if necessary, and colouring the exposed districts, the whole map can be coloured. Mr. Kempe also shows *inter alia* that while the theorem is true in the case of globular surfaces as well as in that of maps, it does not hold in the case of such a surface as an anchor-ring.

We have received a copy of the second part of Mr. W. B. Hemsley's "Diagnoses Plantarum Novarum Mexicanarum et Centrali-Americanarum." We believe that the whole of the MSS. of the *Polypetalæ* of the botany of Messrs. Godman and Salvin's "Biologia Centrali-Americana," is now in the hands of the printer, and Mr. Hemsley is far advanced with the *Gamopetalæ*. The first part of the Polypetalæ will shortly appear. The publication of the Polypetalæ has been delayed, in order to include a very valuable collection made last year in the State of San Luis Potosi, Mexico, by Drs. Parry and Palmer.

A series of interesting experiments with the electric light commenced, by order of the authorities, at the School of Military Engineering, Chatham, on Thursday last. The experiments are for testing the relative qualities of the several inventions now in use in the Army and Navy, including Messrs. Wylde's invention (which has been fitted on board nearly all the larger ironclads in the Navy), Messrs. Siemens' invention, the Gramme light, and others. The experiments, it is expected, will last several weeks, and they will be carried out under the direction of Capt. Armstrong, R.E., instructor in telegraphy at the School of Military Engineering.

The Council of the Institution of Civil Engineers have recently made their annual awards, out of special funds bequeathed for the purpose, for approved original communications read and discussed at the weekly meetings during the past session, or printed in the "Minutes of Proceedings" without being read, as well as for papers submitted by students. From the Telford Fund medals and premiums have been bestowed on Messrs. G. F. Deacon, J. B. Mackenzie, J. N. Douglass, A. F. Blandy, E. Dobson, J. Price, J. E. Williams, G. W. Sutcliffe, E. Sang, W. G. Laws, and G. Higgin. The Manby Premium has fallen to Mr. J. P. Griffith. Miller Prizes have been adjudged to the following students:—Messrs. A. C. Hurtzig, R. H. Read, J. C. Mackay, and P. W. Britton.

The fourth marine excursion of the Birmingham Natural History and Microscopical Society to Falmouth, which extended from July 5 to 14, has proved a great success, and quite equalled, if not surpassed, the preceding ones to Teignmouth and the Island of Arran. A larger number of members than usual joined the party, which consisted of nine ladies and twenty-two gentlemen—a total of thirty-one. As hitherto the excursion was arranged so as to give facilities for the study of the marine zoology, botany, and geology of the district. For the former of these an admirable little steam tug, the *Albert*, was engaged. Land excursions were also arranged daily to interesting points, including the Land's End, the Lizard, &c. For the first time

the members had an opportunity of getting out into deep water of from forty to fifty fathoms, and a most interesting and valuable series of specimens was taken in all classes from diatoms up to fishes. The most noteworthy capture by the dredge in water of fifty fathoms off the Bay, was a specimen of the rare Alcyonarian zoophyte, *Virgularia mirabilis*. In the evenings the specimens taken were exhibited in the ladies' drawing room, some under the microscopes, under the superintendence of Mr. Marshall and Mr. Bolton. The botanists have not been idle, and nearly 400 species of flowering plants have been gathered, besides ferns of many species and varieties. A noteworthy circumstance connected with this excursion has been the kind assistance rendered by local naturalists, among whom are Mr. Howard Fox, the Rev. W. Rogers, Mr. Thomas Cornish, Mr. Tressidder, &c. Some valuable suggestions and encouraging remarks were also made in letters from eminent naturalists in special branches, viz., Prof. Allmann, Dr. Gwyn Jeffreys, Mr. P. H. Gosse, and Mr. H. J. Carter. On Thursday Mr. Saville Kent joined the party, accompanied the dredgings, and kindly rendered very valuable help. Full reports of the excursion will be presented to the Society in due course from the members who are going over the specimens; in marine zoology by Mr. Graham, the President, Mr. Saville-Kent, Mr. Wills, Mr. Trye, and Mr. Hughes; in botany by Mr. Baxenall and Mr. Morley; and in geology by Mr. Burman and Mr. Cotterell. Every effort was made for the comfort of the visitors by the obliging manager of the Falmouth Hotel, where the party took up their quarters, and the hon. sec., Mr. Morley, was indefatigable in his efforts to make the excursion successful. Not the least enjoyable part of the excursion was the really beautiful weather, which was fine and bracing during nearly the whole period. The twentieth annual Report of this Society speaks favourably of its progress, and the more active part taken by the members in its proceedings. Some consideration has been given to plans for utilising the energy of the Society in developing original research and knowledge of natural histology. Circumstances have interfered to prevent immediate action, but we hope that before long the Society will be able to carry its plan into execution.

AT the anniversary meeting of the Sanitary Institute of Great Britain the annual address was delivered by Mr. G. J. Symons, F.R.S., on "Water Economy." Mr. Symons, in the first part of his address, explained the circumstances which combined to render the small areas in the kingdom on which upwards of 75 inches of rain fell annually, of great national importance. Almost all these districts of heavy rain were districts of hard rocks, of steep slopes, and of sparse population. The first of these conditions insured the permanency of the physical geography of the district—the rocks being too hard to be washed away—and therefore the permanency of the rainfall; the second lessened evaporation, and sent the water rapidly into the streams or lakes; and the third tended to insure the purity of the effluent water. Having traced the water from the clouds to the earth, he next considered the effect of soil, crops, inclination of ground, &c., upon the water thus precipitated. He showed the necessity for modifying our customs and laws respecting rivers and watercourses, &c., in conformity with the advance of civilisation and the increasing population of the country. He recommended that the entire administration of streams should be under a single direction, which should see to all questions of drainage, sewerage, canalisation, motive power, and water supply. Such new works as were required promptly should only be authorised subject to their reverting to Government in fifty or a hundred years. All other hydraulic works should be undertaken, or at all events supervised, by a Government department, so as to insure the greatest possible public benefit and not merely that of an individual town.

MR. R. ANDERSON, F.C.S., whose paper on Lightning Conductors and Accidents from Lightning attracted considerable attention at the last meeting of the British Association, has for some time been engaged on a large work treating the subject from a scientific, practical, and historical point of view. The book is now nearly ready, and will be published in a few weeks.

WE have received from Mr. William George of Park Street, Bristol, the first four numbers of an interesting catalogue of works referring, *inter alia*, to geography, geology, chemistry, and other branches of science. The catalogue displays a considerable knowledge of the bibliography of these subjects, and would, no doubt, interest many of our readers.

AMONG Mr. Murray's announcements are: "The River of Golden Sand; a Narrative of a Journey through China to Burmah," by Capt. Wm. Gill, R.E.; "A Lady's Life in the Rocky Mountains," and "Japanese Letters," by Miss Isabella Bird; "A Sketch of the Life of Erasmus Darwin," by Dr. Krauss, translated from the German, with a preliminary notice, by Charles Darwin, F.R.S.; "Metallurgy, Part V., Silver and Part of Gold," by Dr. J. Percy, F.R.S.

THOSE of our readers interested in India may be glad to know that Mr. Quaritch has on sale the second edition of Balfour's monumental Cyclopædia of India.

M. W. DE FONVIELLE writes:—"On July 9 I made an ascent at Douay in a small balloon, at 5.30 P.M., with a strong west-south-west wind; velocity, 1 kilometre per minute. The temperature varied from 12° to 14° C. according to the exposure, and the altitude from 900 to 1,300 metres. From 800 to 1,000 were small floating clouds of irregular shape, not more than 100 metres in altitude and 200 metres in transverse dimension, but very dense, obviously formed with pure water, without any snowy matter. We observed at six different times the white rainbow, or Ulloa Circle, at the superior surface of this cloud. This dispels the notion, published in so many text-books, that it is seen only on icicles. There were three circles—interior blue, medium yellow, and exterior red. I had not a sextant for measuring the diameter, which I suppose was not more than 25 to 30 degrees for the exterior circle, somewhat less than the little halo, and in all cases about the same, irrespective of the distance of clouds. It was, of course, seen opposite the sun. The interior part was quite silvery white, being merely reflected light from the sun. The shadow of the car, travellers, and balloon was seen in the centre with angular dimensions varying according to the distance of the clouds. The shadow was sometimes projected outside the luminous circles, being too large to be included. Once we saw distinctly a luminous circle developing round the balloon, and we had two coloured images at once. The balloon phenomenon did not last long enough to be carefully observed; it appeared less distinct. I recollect only the reddish part of it, but we are both certain of its appearance. I suggest the acceptance of the explanation given by Bravais of the white rainbow, that it is produced by the reflection of the sun's rays on the surface of small vapoury vesicles, composed of a little quantity of air imprisoned by a shell of water. I noted also a curious optical illusion of a kind which was indicated to me by Mr. Coxwell a few years ago. When the clouds were at some distance they appeared almost at the same level, and I was under the impression that the balloon was ascending as they were passing under the car at some distance below. But the barometer and other circumstances proved we were keeping almost a perfect vertical equilibrium, and travelling in a horizontal direction."

W. B. F., writing from Point-of-Air, North Wales, on the 14th inst., states that an earthquake was observed there that morning at 1.5 A.M. The direction of the undulation appeared to be from a little to the east of south to a little to the west of

north. The movement of the earth was plainly felt by several persons in the neighbourhood. Previous to the shock the night was clear, warm, and calm, with a slight air from the south-west; twenty minutes after the shock there was a thunderstorm, accompanied by very heavy rain.

FROM a statement in the House of Commons by the Under-Secretary of State, it seems that the distribution of the Indian Museum collections has not yet been determined on, and is the subject of investigation by a committee in communication with the authorities at the British Museum, South Kensington, and Kew Gardens. The main object which is expected to be gained by this step is the increased utility of the collections to the public. The Economic Section, for instance, it was stated, could be maintained and perfected with great public advantage in the experienced hands of Sir Joseph Hooker at Kew, where he already has a far better collection of similar objects; while as regards the zoological, ethnological, and art collections, their transfer to departments where they will be more generally seen and appreciated, seems better than to retain them in a museum which, somehow or other, does not attract visitors. The fact that 9,000*l.* a year will be saved to the Indian revenues, may not have been without weight in deciding to break up the Museum.

THE *Daily News* New York correspondent telegraphs as follows :—"Mr. Edison has partially overcome the obstacle to his electric light offered by the high price of platinum. His lamps, instead of costing several dollars apiece, as at first, can now be made of an alloy of platinum with inferior metals, so as to cost only fifty-six cents. He announces that he can now produce the spiral coil for incandescence at a price which all who use gas can easily afford, and that his efforts to find platinum are only induced by the desire to reduce the cost of burners still further."

NO. 27 of the *Journal* of the Society of Telegraph Engineers contains an important paper, by Col. Bolton : "Some Historical Notes on the Electric Light," consisting of abstracts from all the English patents on dynamo- and magneto-electric machines and on electric lights, classified and arranged in subdivisions according to the special class feature of each form of machine or lamp. From these abstracts it will be seen that several of the so-called new inventions on this subject that have been attracting so much attention of late are really inventions of long ago.

IN recent researches (described to the Vienna Academy) on the specific viscosity of liquids and its relation to chemical constitution, Herr Pribram and Herr Handl have observed (1) that the substitution of Cl, Br, I, and NO_2 for H in a molecule, caused, in all cases examined, an increase in the time of flow (through a capillary tube); (2) that this increase was least on substitution of Cl, and more, successively, in those of Br, I, and NO_2; (3) that for the absolute value of increase of the time of flow, not only the quality of the element introduced, but also its position in the molecule, is a determinant.

ACCORDING to Prof. Du Bois Reymond, grave sounds should be more weakened by telephonic transmission than acute sounds (causing an alteration of *timbre*), but all sounds, whatever their pitch, suffer a retardation of a quarter of a wave. On the other hand Prof. Helmholtz, by a theory apparently more complete, finds that all sounds are weakened nearly in the same proportion, and that the difference of phase introduced must be very small. M. Koening has recently made experiments with a view to decide the question. He substitutes two tuning-forks, A and B, for the membranes of two associated telephones, and vibrates A with the bow; at once B enters into vibration, and one may, either by observing successively with an optical comparing instrument, the vibrations of A and B, or by arranging A and B as in the well-known experiment of M. Lissajous for composition of rectangular vibratory movements, measure the difference of phase of the tuning-forks, which is found exactly equal to a quarter of a wave-length. An experiment on complex sounds was made by changing one fork Ut_1 for fork Ut_4 so as to produce simultaneously the sounds 1 and 8 before the bar of a telephone. The difference of phase was still found equal to a quarter of a wave. Thus Du Bois Reymond's view is more in accord with experiment than that of Helmholtz.

ACCORDING to Herr Kohlrausch (*Ann. der Physik*, No. 6) well-defined tones may be produced in a simple way by only two impulses. Place two fingers of the hand loosely together, so that the end of the nails are about on a level, and then tap gently on the table, the proper tone of this having been deadened as much as possible by means of books, or sitting on it, or otherwise. It will be readily felt that the two fingers seldom strike quite simultaneously, and with some attention one may hear (best if the tapping be repeated twice or thrice in a second) in addition to the noise, of indeterminate pitch, a very bald tone of pitch varying at first with the position of the fingers, but which, after a little practice, one can approximately fix. It is also possible to give a musical interval by tapping twice with the fingers differently adjusted; Herr Kohlrausch says he has often perceived differences of pitch to the extent of a semitone. Within the interval 15 : 16, then, the tones of only two impulses can be accurately determined. Tapping with only one fingernail these tones entirely disappear; and one may therefore easily learn to hear them by tapping alternately with the one and with the two fingers.

IN a recent paper to the Belgian Academy M. Renard endeavours to fix the distinctive characters of calcite and dolomite in rocks which contain these two elements associated in microscopic individuals. After showing that the characters on which the distinction has been established hitherto are not satisfactory, he substitutes the character which dolomite has of appearing nearly always with the form of the original rhombohedron, whereas calcite never, one may say, affects this crystalline form. It results from his observations that the dolomites which do not belong to the normal type must be considered as mechanical mixtures of dolomite and calcite, and not as combinations in which the excess of one of the two constituent bases must be interpreted according to the laws of isomorphism. M. Renard supports his determinations by chemical researches under the microscope, and, in concluding, he points out that in the case of several dolomitic rocks of carboniferous limestone, the dolomitisation is due to an action posterior to the sedimentation of the calcareous elements.

WILLUGHBY, not Willoughby (as printed in last week's NATURE) is the name of the new society for reprinting scarce ornithological works, which takes its name from Francis Willughby, the pupil and patron of John Ray, who first edited and then translated his "Ornithologiæ Libri tres," besides his ichthyological works.

THE International African Association have just published a note by Dr. Dutrieux, of the Belgian African Expedition, on the subject of a parasitical cutaneous affection which he has had opportunities of observing during his journey. The parasite especially attacks oxen, whence it is called *founza ia ngômbé* (ox-worm). The negroes suffer a good deal from it, and it appears to burrow into different parts of their feet. When it is extracted, in consequence of their always going barefooted, they get very painful ulcers, which Dr. Dutrieux says are exceedingly difficult to cure.

THE new number of the *Indian Forester* contains a paper of much interest on the Banda Forests, and the continuation of another on the function of the pines and the larch in the production of soil. There is also a letter which furnishes some curious notes

on the coppicing powers of certain trees in dry and arid climates.

THE *Annual Report* of the Society of Arts for 1878-9, shows, as might be expected, that during the past session, a vast amount of good and useful work has been done under its auspices. As to the material condition of the Society the report is favourable, notwithstanding the badness of the times.

THE Report of the Auckland (N.Z.) Institute for 1878-9, speaks of the steady progress of the Society, and the increasing interest manifested by the public in its operations. Several valuable papers on New Zealand natural history have been read.

WE have received a number of little Guides for Science Teaching, issued by the Boston (U.S.) Society of Natural History. The enterprise is creditable to the Society, and the "Guides" seem to us to be handy and trustworthy. Some of them are reprints and second editions. They are—"About Pebbles," by Alpheus Wyatt; "Concerning a Few Common Plants," by G. L. Goodall: "Commercial and other Sponges," by A. Wyatt; a reprint of Mrs. Agassiz's "First Lesson in Natural History;" "Common Hydroids, Corals, and Echinoderms," by A. Wyatt. The last three are very fully illustrated.

WE have received from Mr. J. T. Peacock, the eminent grower of succulent plants, a list of the plants cultivated by him; these comprise cacti, agaves, yuccas, sempervivums, euphorbias, and in fact all plants of a succulent or fleshy nature, many of which have hitherto been much neglected by cultivators. The extent of Mr. Peacock's collection may be judged from the fact that at the present time portions are contained at Sudbury House, Kew, the Alexandra Palace, and the Botanical Gardens, Regent's Park. For the purpose of making this class of Plants more generally appreciated among amateurs Mr. Peacock intends sending the printed list to applicants who send an addressed halfpenny wrapper to Sudbury House, Hammersmith.

THE *Allgemeine Zeitung* reports important anthropological discoveries in Moravia. Excavations have been going on for some months back under the direction of Herr Carl Maschka, a specialist in these subjects, in the Shipka and Tschertowa Dira caves, near Stramberg. The discoveries, it is stated, have been made in layers, carrying the investigator back step by step to the palæolithic age. Stone and bronze weapons, with bones of a variety of animals belonging to different periods, appear to have been found in large numbers.

OWING to the great cost and often very inferior quality of gas, the *Colonies and India* states that for street lighting the electric light is coming into favour in many parts of Australia, and in South Africa particularly; and when the problem of subdividing the light for use in small houses is satisfactorily solved, it will find a wide field in which it can establish itself more rapidly than will be the case in England.

A JAPANESE paper states that some chemists have discovered a vein of silver at Yuigahara, in Kioto-Fu. The water of a pond in the neighbourhood being discoloured, their curiosity was excited as to the cause, and a search for minerals in the vicinity resulted in the discovery mentioned.

FROM the Third Annual Report of the Burton-on-Trent Natural History and Archæological Society, it seems to be in a prosperous condition. It forms one of the Midland Union of Natural History Societies, and the work it is doing is on the whole creditable.

THE additions to the Zoological Society's Gardens during the past week include two Crested Porcupines (*Hystrix cristata*) from West Africa, presented by Mr. Moses Boyle; a Black-winged Peafowl (*Pavo nigripennis*) from Cochin China, presented by the Hon. A. S. G. Canning, F.Z.S.; a Buff-backed Egret (*Ardea russata*), European, six Small-scaled Mastigures (*Uromastix microlepis*) from Busreh, presented by Capt. Burke, s.s. *Arcot;* a Gold Pheasant (*Thaumalea picta*) from China, presented by Mr. J. E. Liardet; two Common Barn Owls (*Strix flammea*), European, presented by Mr. R. A. Baldwin; an Indian Python (*Python molurus*) from India, a South American Rat Snake (*Spilotes variabilis*) from South America, presented by Mr. George Billett; two Elliot's Guinea Fowls (*Numida elliotî*), four Vulturine Guinea Fowls (*Numida vulturina*) from East Africa, deposited; a Striped Hyæna (*Hyæna striata*) from India, a Yellow-footed Rock Kangaroo (*Petrogale xanthopus*), four Black Swans (*Cygnus atratus*) from Australia, two Balearic Cranes (*Balearica pavonina*), four Rose-ringed Parrakeets (*Palæornis docilis*) from West Africa, two Siamese Pheasants (*Euplocamus prælatus*) from Siam, a Darwin's Pucras Pheasant (*Pucrasiæ darwini*) from China, purchased; a Japanese Deer (*Cervus sika*), born in the Gardens; three Australian Wild Ducks (*Anas superciliosa*), a Spotted-billed Duck (*Anas pœcilorhyncha*), six Rosy-billed Ducks (*Metopiana peposaca*), bred in the Gardens.

HOLLWAY'S NEW APPLICATION OF RAPID OXIDATION BY WHICH SULPHIDES ARE UTILISED AS FUEL[1]

THIS process has for its object the utilisation of the heat generated by the rapid oxidation of certain mineral substances, which have not hitherto been used as sources of heat for smelting operations. The heat thus obtained is employed in the reduction of the furnace charge, which may be composed partly of sulphides and partly of siliceous ores. A current of air is forced through molten sulphides, by which means they are very rapidly oxidised. Great heat is thus developed, rendering the process of smelting a self-supporting operation; therefore no extraneous fuel is required, excepting that employed in raising steam for the blowing engines; where, however, water power is available, steam can be dispensed with, in which case all the carbonaceous fuel necessary for the operation is a little coke to start the furnaces, which stands in the same relative position to the ores as wood does to coal in the lighting of an ordinary fire.

It is well known that pyritous minerals are readily combustible, but the best means of utilising the heat-producing property of metallic sulphides is not so apparent as would at first sight appear. Of these sulphides only iron pyrites is sufficiently combustible at a low temperature to burn in the open air, the mass being raised to the temperature at which the oxidation takes place solely by the union of sulphur and iron with atmospheric oxygen. In Spain there are numerous deposits of poor cupreous pyrites, and the Rio Tinto and Tharsis Companies annually treat, at their mines, about one million tons for the extraction of copper only, which does not average 2 per cent. The process employed consists essentially in roasting the pyrites in heaps in the open air, dissolving out the copper from the roasted material, and precipitating it from the solution by means of iron. These operations extend over several months; any gold or silver contained in the ore is lost, and the iron and sulphur are also wasted. The sulphur passes into the air as an obnoxious and annoying gas, desolating the country for miles around the works.

From the earliest ages, carbon has been considered a necessity in all metallurgical operations. The first reduction of metals by means of carbon forms a connecting link between the age of stone and the commencement of civilised art. It is well known that carbon burns at widely varying temperatures, as, for example, in our bodies, in a common coal fire, or in a furnace. A great deal of thought has been devoted to the subject of economising carbonaceous fuel, and great advances have been made in this direction; yet the expenditure of coal or coke necessary, say, to melt a given quantity of metal, still far exceeds the theoretical limit. The main causes of this discrepancy may be accounted for as follows:—

1. Only part of the oxygen of the air passing into a furnace, acts on the material to be burnt.

2. The oxygen is not brought in contact with the combustible matter with sufficient rapidity, to obtain the necessary temperature for the operation.

3. Gases pass off hot and unburnt. These are now, however, frequently utilised.

[1] Communicated by Mr. Hollway.